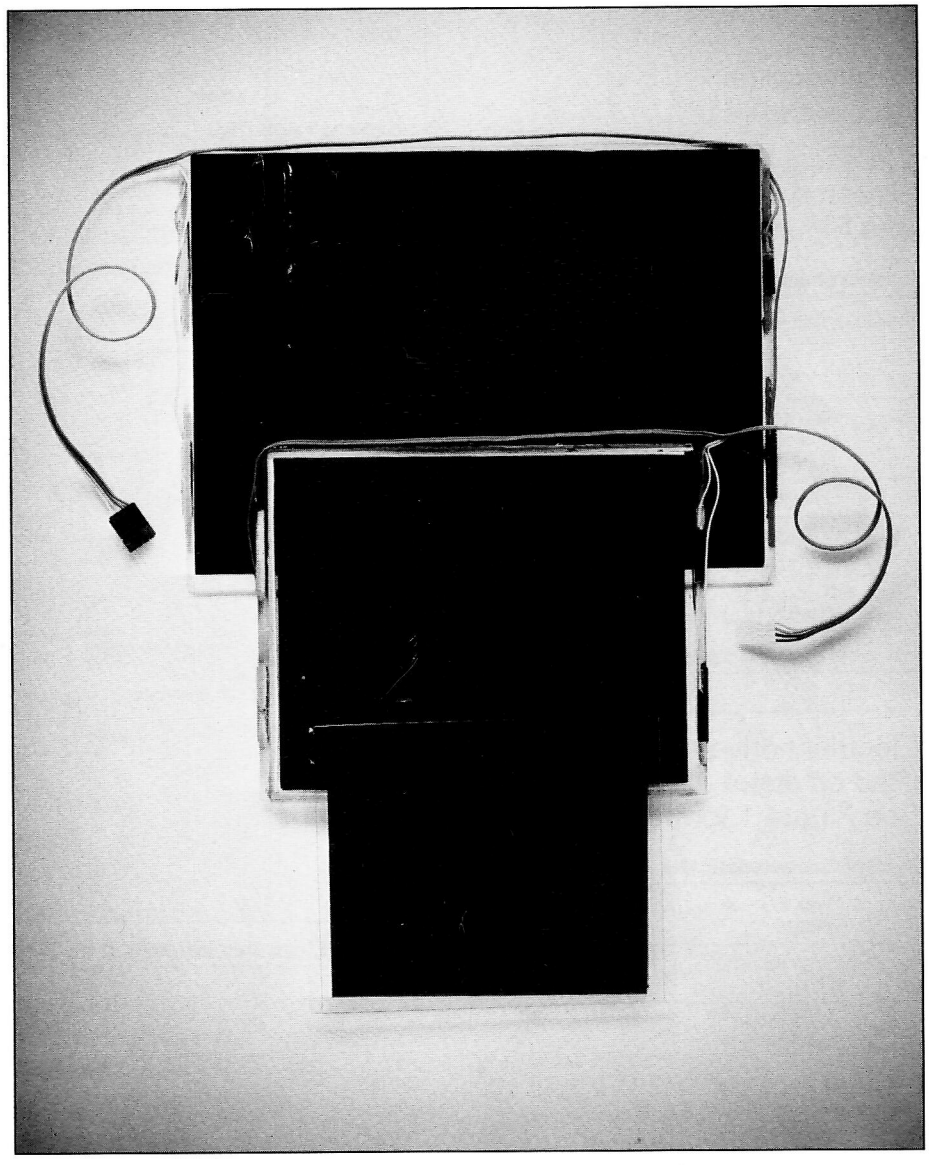
LIQUID CRYSTAL SHUTTER

Now Available: 12, 15, and 19-inch Liquid Crystal Shutters (See Insert inside).



Description

The Liquid Crystal Shutter (LCS) is available in 5, 7 and 9-inch diagonal versions, for use with raster or vector CRT display systems. Combined with a monochrome CRT display, the Liquid Crystal Shutter provides a field-sequential color display without affecting the monochrome CRT's resolution. The Liquid Crystal Shutter offers significant advantages over traditional color display technologies that use shadow-masks or penetration phosphors:

- Monochrome resolution along with color (based on spot size of monochrome CRT)
- Excellent contrast (even in high ambient light)
- Inherent convergence (all screen writing achieved with single gun)
- Larger usable viewing area (shadow-mask not used)
- Smaller package (used with a monochrome CRT – not a larger color CRT)
- Ruggedness (shadow-mask or complex electron gun not used).

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Absolute Maximum Ratings

Electrical (10 sec. max.)

Symbol	Characteristic	Value	Unit
VAC	PP AC Volts (Any terminal to any terminal)	60	Vpp
Fmax	Frequency (Any terminal to any terminal)	25	kHz
DC V	Maximum DC Volts (10 s or less)	60	V
T max	ABS max. temp. (10 min. or less)	100	°C

Performance Characteristics

Electrical drive (Green *on* state) See Figure 1 for parameters

Symbol	Characteristic	Min.	Typ.	Max.	Unit
Vppg	Peak to Peak driver voltage:				
	5, 7 Inch	38	40	50	V
	9-Inch	45	50	60	V
Tr	Rise time of drive signal (10-90%)	–		50	μs
F	Drive frequency	1.8	2	4.0	KHz
V DC	Continuous DC offset			50	mV
T on	On duration (Green state)	1.0	6.7	∞	ms

Electrical drive (Red *off* state) See Figure 1 for parameter

Symbol	Characteristic	Min.	Typ.	Max.	Unit
Vppr	Peak to Peak voltage	0	0	0.50	V
Vdc	Continuous DC offset	–	–	50	mV
T off	Off duration (Red state)	–	10	14	ms

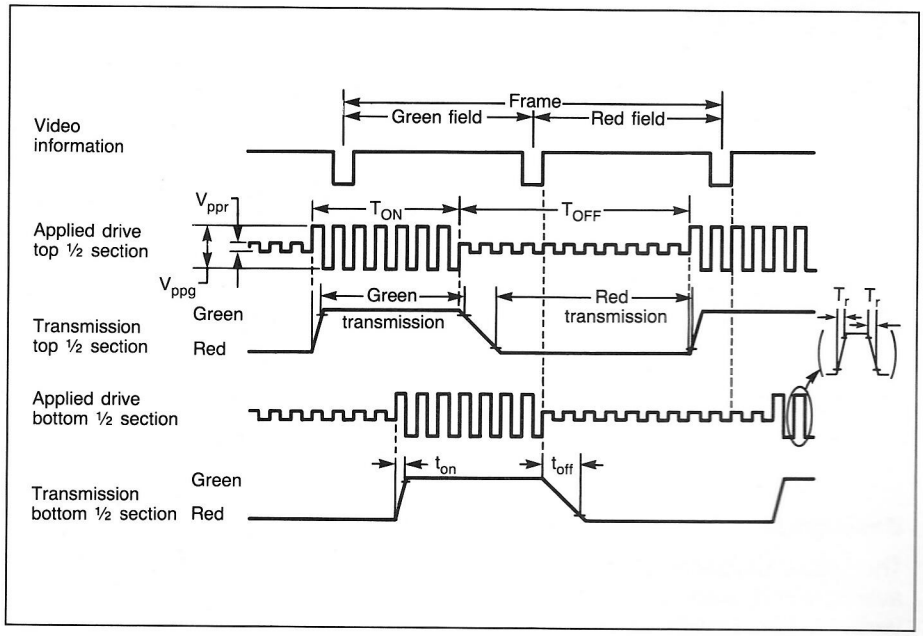


Figure 1. Typical implementation of LCS in raster scan applications

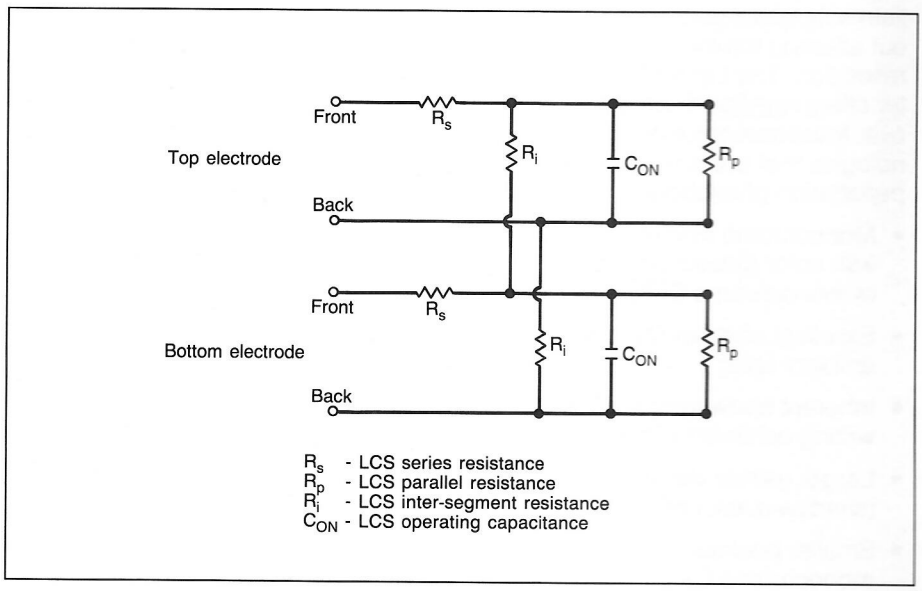


Figure 2. Electronic equivalent impedance of LCS

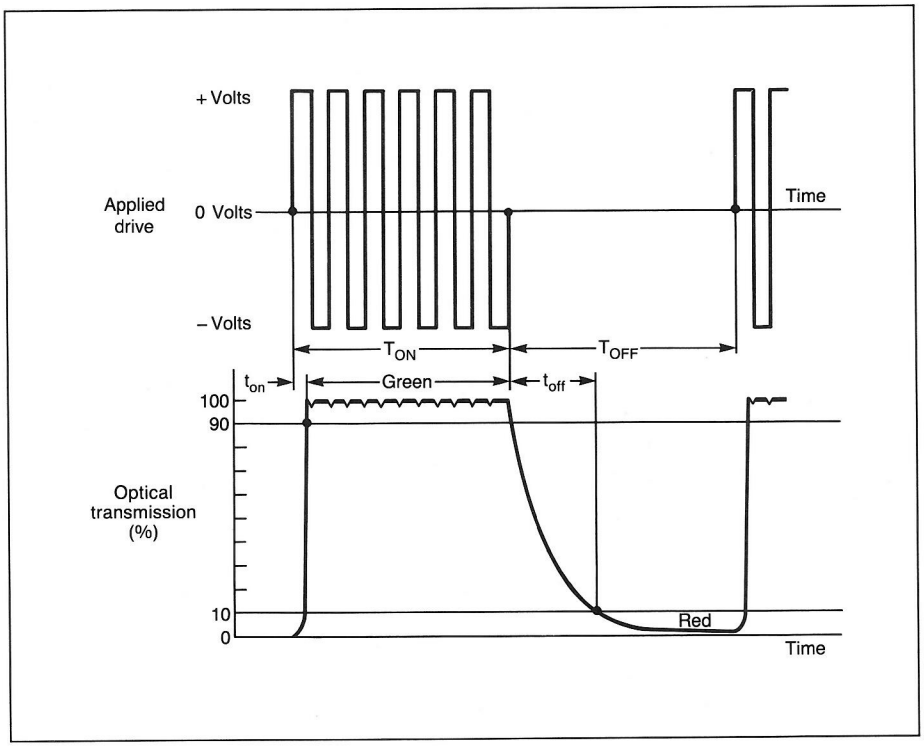


Figure 3. Optical transmission of LCS at 545 nm

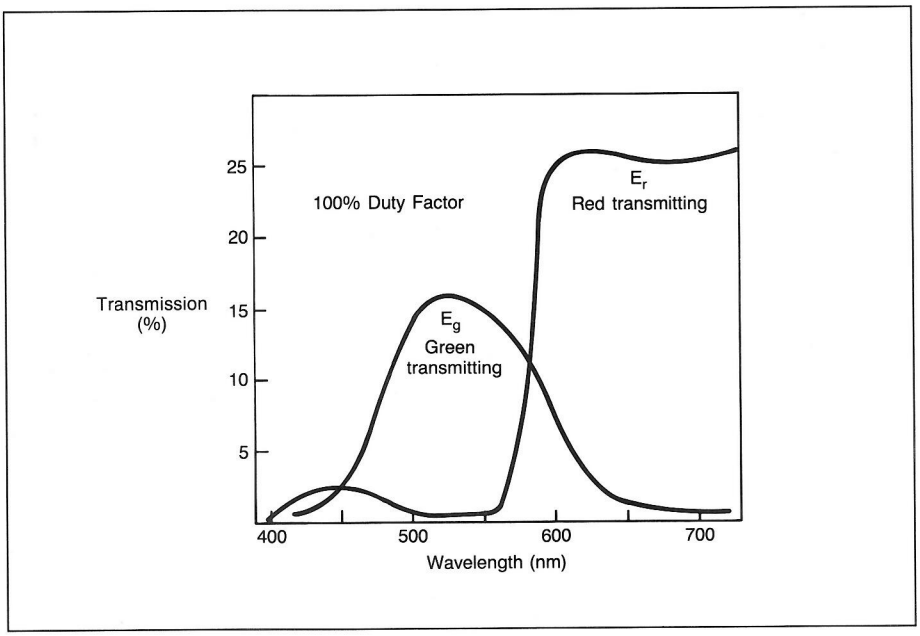


Figure 4. Typical LCS transmission in the visible spectrum

Electronic equivalent impedence (For each 1/2 cell electrode) See Figure 2 for equivalent circuit

Symbol	Characteristic	Min.	Typ.	Max.	Unit
Rs	LCS series resistance	100	150	300	Ω
Rp	LCS parallel resistance	.1	10	–	MΩ
Ri	Intersegment resistance	1	–	–	MΩ
C on	LCS operating capacitance:				
	5-Inch	.06	.08	.10	μF
	7-Inch	.12	.15	.18	μF
	9-Inch	.16	.20	.24	μF
C off	capacitance (<1vpp drive):				
	5-Inch	–	.03	–	μF
	7-Inch	–	.05	–	μF
	9-Inch	–	.08	–	μF
ip	Peak current:				
	5-Inch	–	270	500	mA
	7-Inch	–	270	500	mA
	9-Inch	–	350	600	mA
P_{AVG}	Power:				
	5-Inch	–	200	500	mW
	7-Inch	–	350	875	mW
	9-Inch	–	500	1250	mW

Optical performance See Figure 3 and Figure 4 for data. T= 10°C to 50°C

Symbol	Characteristic	Min.	Typ.	Max.	Unit
t on	Turn-on time	–	.2	.35	ms
t off	Turn-off time	–	2.0	3.2	ms
E_g	Green light transmitted (550nm)				
	LCS *on*	15	18	–	%
	LCS *off*	–	1	–	%
E_r	Red light transmitted (625nm)				
	LCS *on*	–	3	–	%
	LCS *off*	26	30	–	%
Tw	Warmup Time (100% D.F.)	–	–	20	s
	(50% D.F. rated drive)	–	20	60	s

D.F. = Duty Factor (T_{on}/T_{off})

Environmental Performance

Characteristics	Min.	Typ.	Max.	Unit
Storage temperature	−20		+60	°C
Operating temperature	+10		+50	°C
Altitude				
Non-operating			50K	Ft
Operating			15K	

UV, Shock and Vibration meets	MIL-STD-18800	Class III
Impact Hammer Test meets	UL 1244C, UL 1418*	
Flamability Test meets	UL 94 V-0	
* Only part nos.	808-0002-00 808-0004-00 808-0006-00	

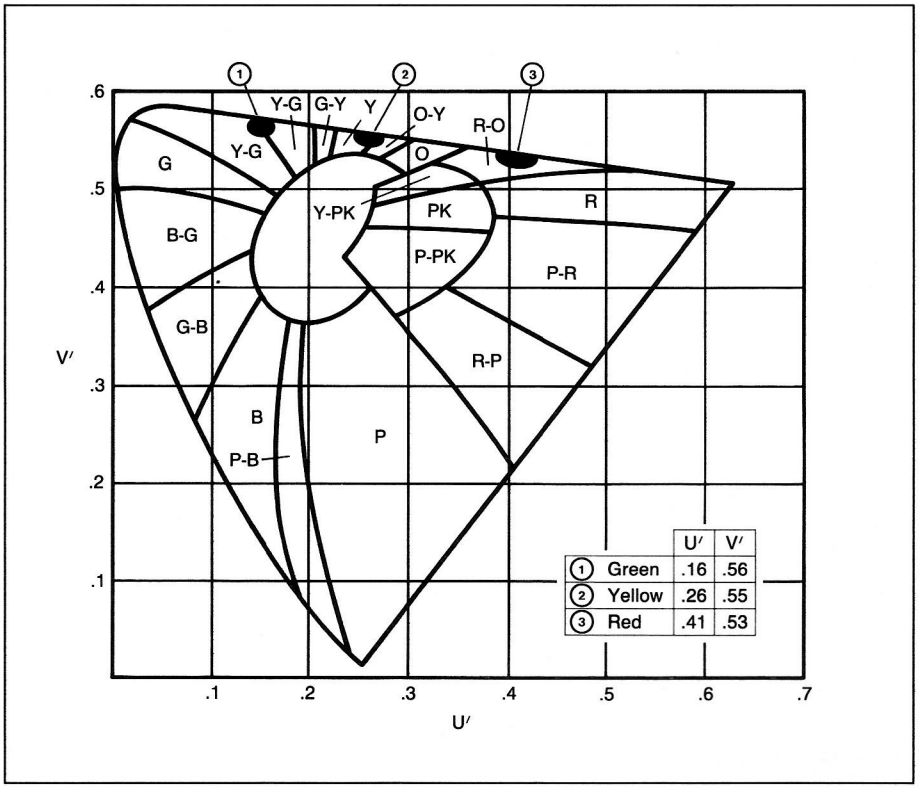


Figure 5. Typical color characteristics (when used with Tektronix KGR2 phosphor)

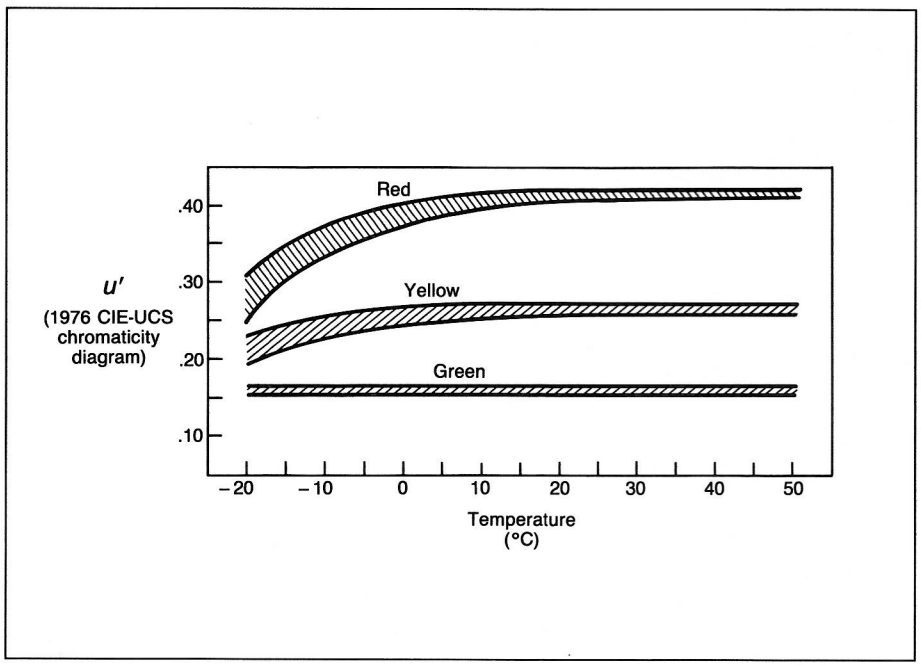


Figure 6. Typical color performance vs temperature (Tektronix KGR-2 phosphor)

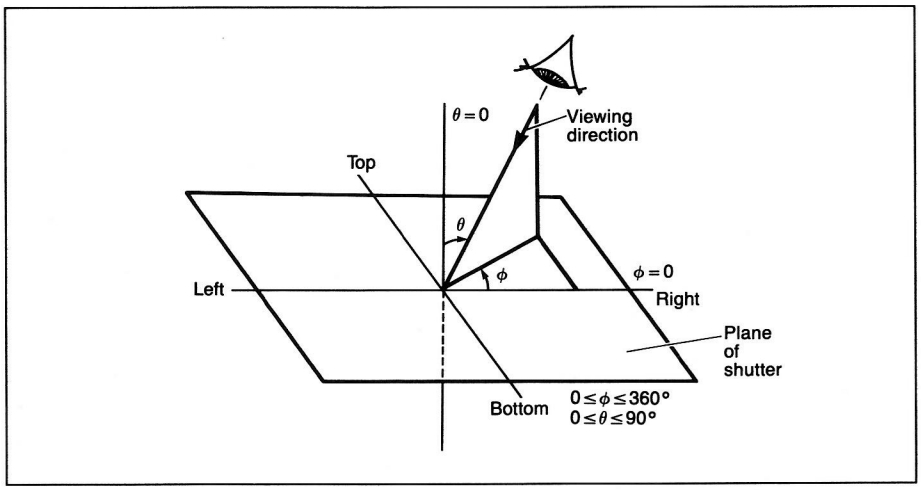


Figure 7. Definition of viewing direction

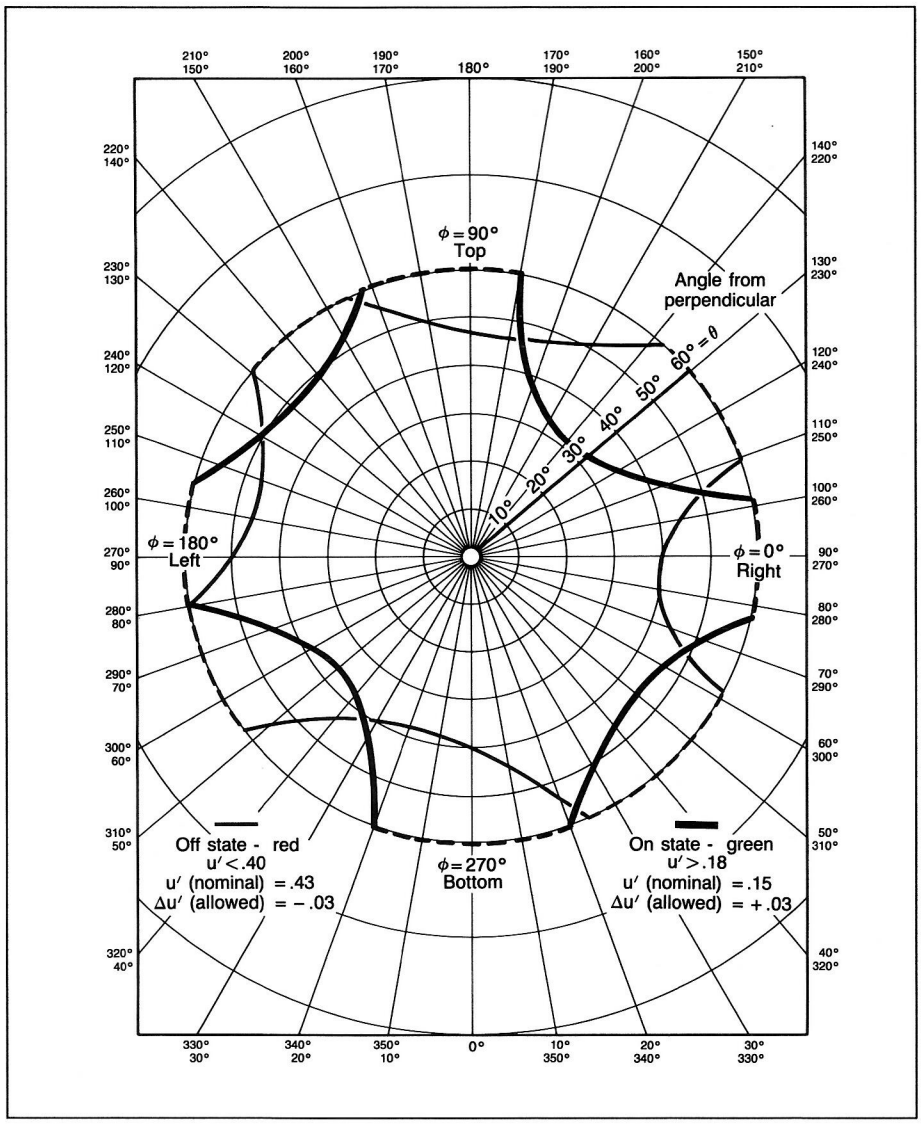


Figure 8. Color purity vs viewing direction

Typical Raster Application (Using Tektronix KGR2 Phosphor @ 25°C)

Frame rate	60 Hz
Field rate	120 Hz
Green field time	8.3 ms
Green phosphor decay time	1.5 ms
LCS turn-off time	2.0 ms
Red field time	8.3 ms
Red phosphor decay time	1.1 ms
LCS turn-on time	0.20 ms

Typical Vector Application (Using Tektronix KGR2 Phosphor @ 25°C)

Max. time in off-state	40 ms
Min. time in on-state (after max. time in off-state)	1 ms
Green phosphor decay time	1.5 ms
LCS turn-off time	2.0 ms
Red phosphor decay time	1.1 ms
LCS turn-on time	0.2 ms

Mechanical

Symbol	Characteristic			Value Unit
Clamping Pressure	Minimum pressure required to maintain shutter position under an 11 ms, 100G half-sine shock, assuming a 4.3 mm rigid perimeter clamping area, and a non-deformable surface.			
		w/o cover glass	w/cover glass	
	5-Inch	6.5	9.7	lb/in²
	7-Inch	8.1	12.6	
	9-Inch	10.4	15.5	

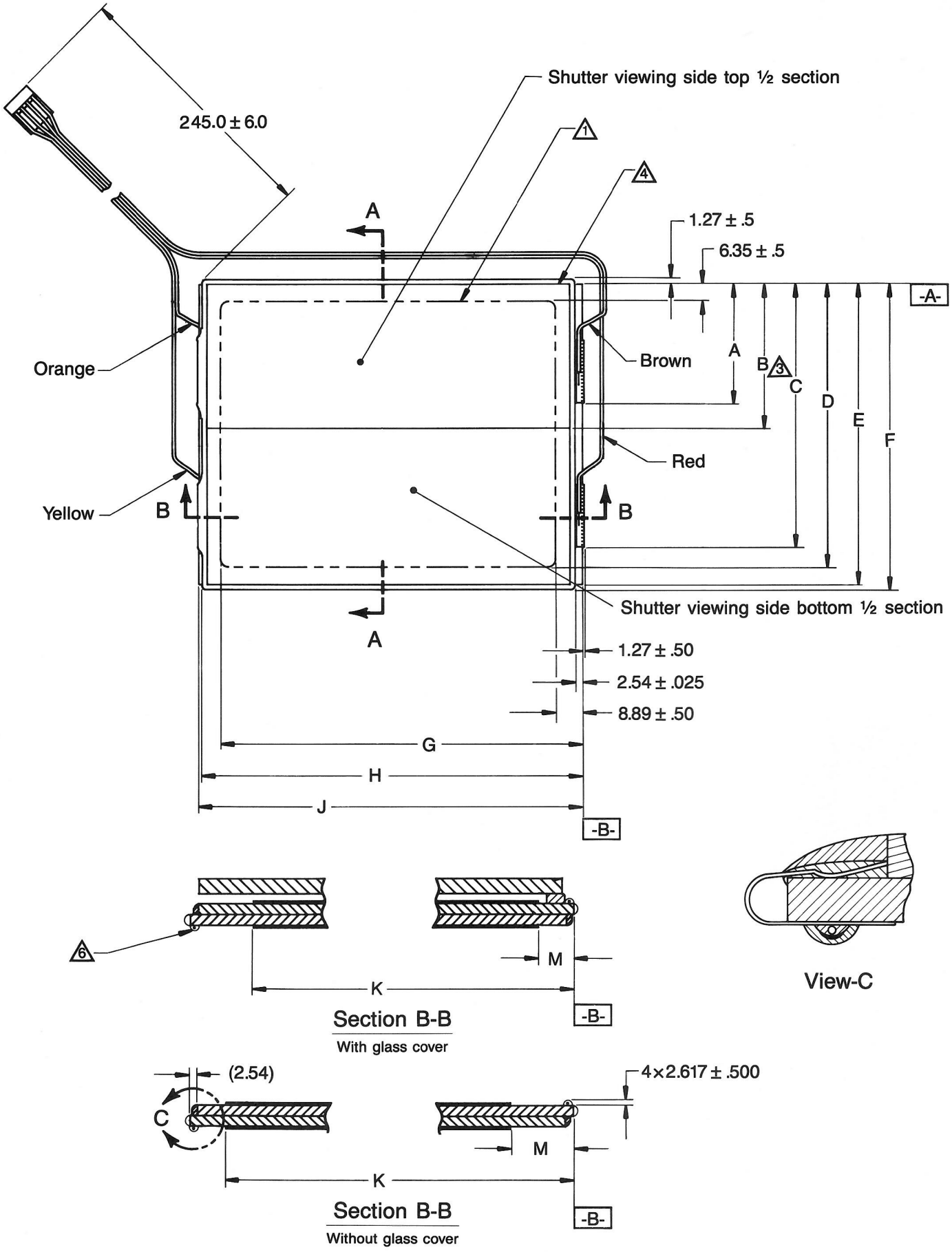
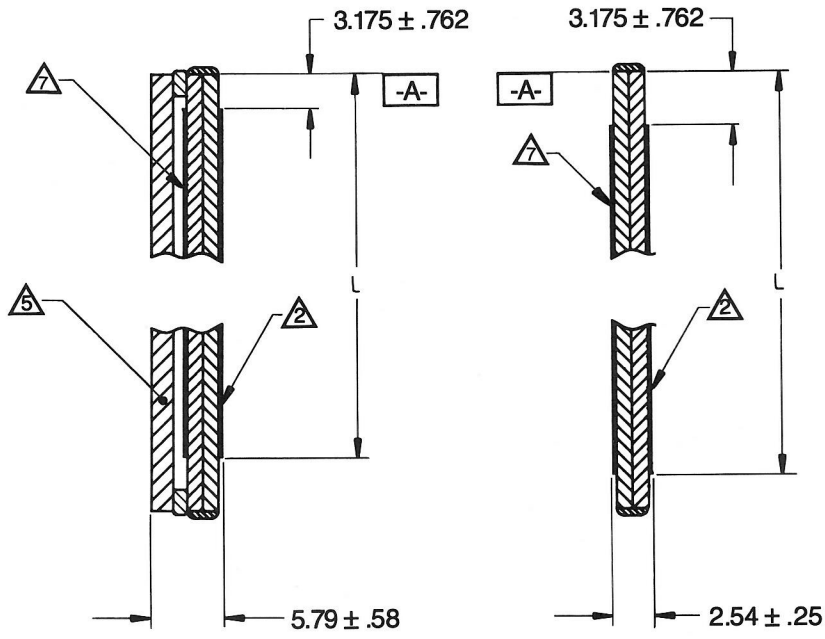


Figure 9. Drawing details, Liquid Crystal Shutter



Section A-A
With glass cover

Section A-A
Without glass cover

Notes:

1. Screen quality area
2. Color polarizer
3. Center split line
4. Environmental seal
5. Glass cover chemically etched for reduced reflection
6. Connector, four locations
7. Linear polarizer

DIMENSION (mm)	5 IN	7 IN	9 IN
A	50.80 ± 1.27	44.45 ± 1.27	37.63 ± 1.27
B	47.63 ± 1.02	60.96 ± 1.02	76.20 ± 1.02
C	83.03 ± 1.27	102.87 ± 1.27	127.00 ± 1.27
D	88.90 ± .50	115.57 ± .50	146.05 ± .50
E	95.25 ± .50	121.92 ± .50	152.40 ± .50
F	96.52 ± .50	123.19 ± .72	153.67 ± .50
G	113.03 ± .50	146.05 ± .50	196.85 ± .50
H	121.92 ± .50	154.94 ± .50	205.74 ± .50
J	123.19 ± .50	156.21 ± .72	207.01 ± .72
K	116.21 ± .84	143.51 ± .84	200.03 ± .84
L	88.90 ± .57	115.57 ± .57	146.05 ± .57
M	5.715 ± .803	6.985 ± .803	5.715 ± .803

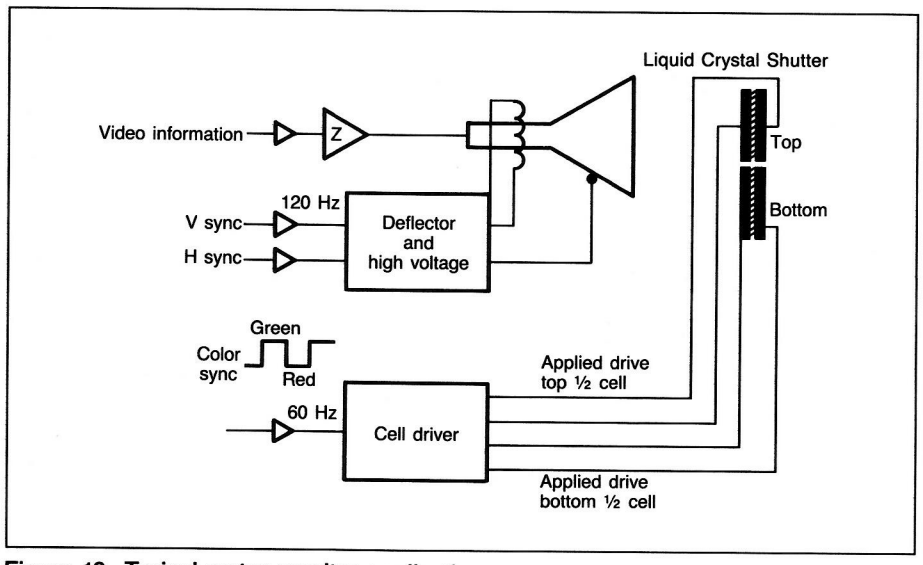


Figure 10. Typical raster monitor application

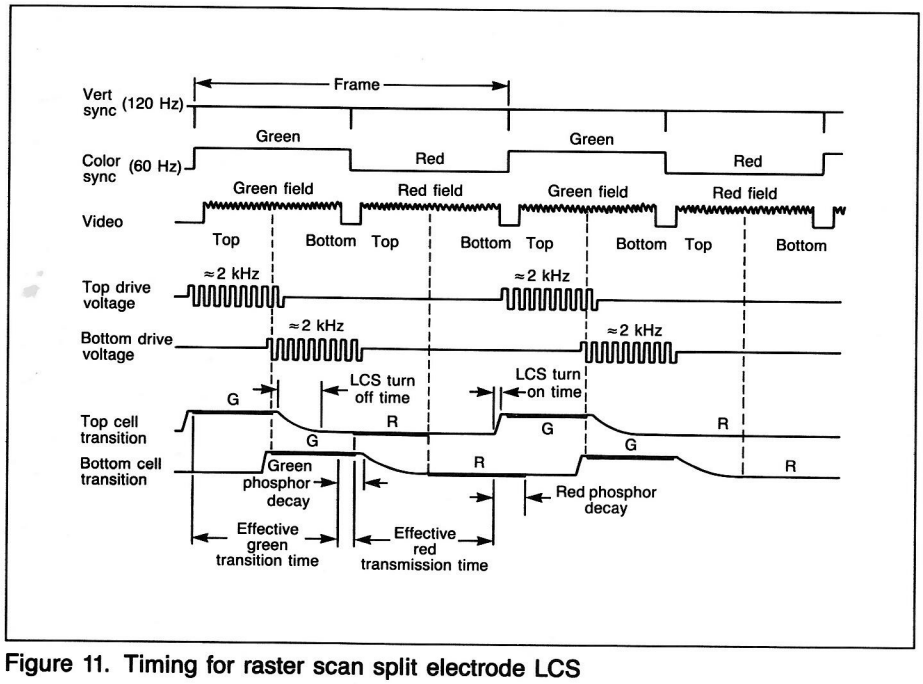


Figure 11. Timing for raster scan split electrode LCS

Ordering Information

Liquid Crystal Shutters	Part Number
5-inch w/o cover glass	808-0004-00
5-inch with cover glass	808-0003-00
7-inch w/o cover glass	808-0006-00
7-inch with cover glass	808-0001-00
9-inch w/o cover glass	808-0002-00
9-inch with cover glass	808-0005-00

CRTs With KGR-2 R/G Color System	Part Number
7-inch	808-0100-00
9-inch	808-0102-00

LCS Driver Circuits	Part Number
For 5 or 7-inch:	
Vector	808-0200-00
Raster	808-0201-00
For 9-inch:	
Vector	808-0202-00
Raster	808-0203-00

For Further Information, Please Contact:

Liquid Crystal Shutters
P.O. Box 500, M.S. 48-300
Beaverton, OR 97077
Phone: (503) 627-6499

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5/85 43W5927

Now Available: 12, 15 and 19-inch Liquid Crystal Shutters

Tektronix Liquid Crystal shutters are now available in 12-inch, 15-inch, and 19-inch diagonal-measure versions, in addition to the 5-inch, 7-inch, and 9-inch sizes already available.

All specifications contained in this Design and Ordering Information Data Sheet also apply to the new sizes, with the exception of dimensions and part numbers. Table 1 lists the new part numbers, Table 2 provides new physical dimensions for the 12, 15, and 19-inch versions.

Table 1
Ordering Information

Liquid Crystal Shutters	Part Number
12-inch w/o cover glass	808-0008-00
15-inch w/o cover glass	808-0013-00
19-inch w/o cover glass	808-0019-00

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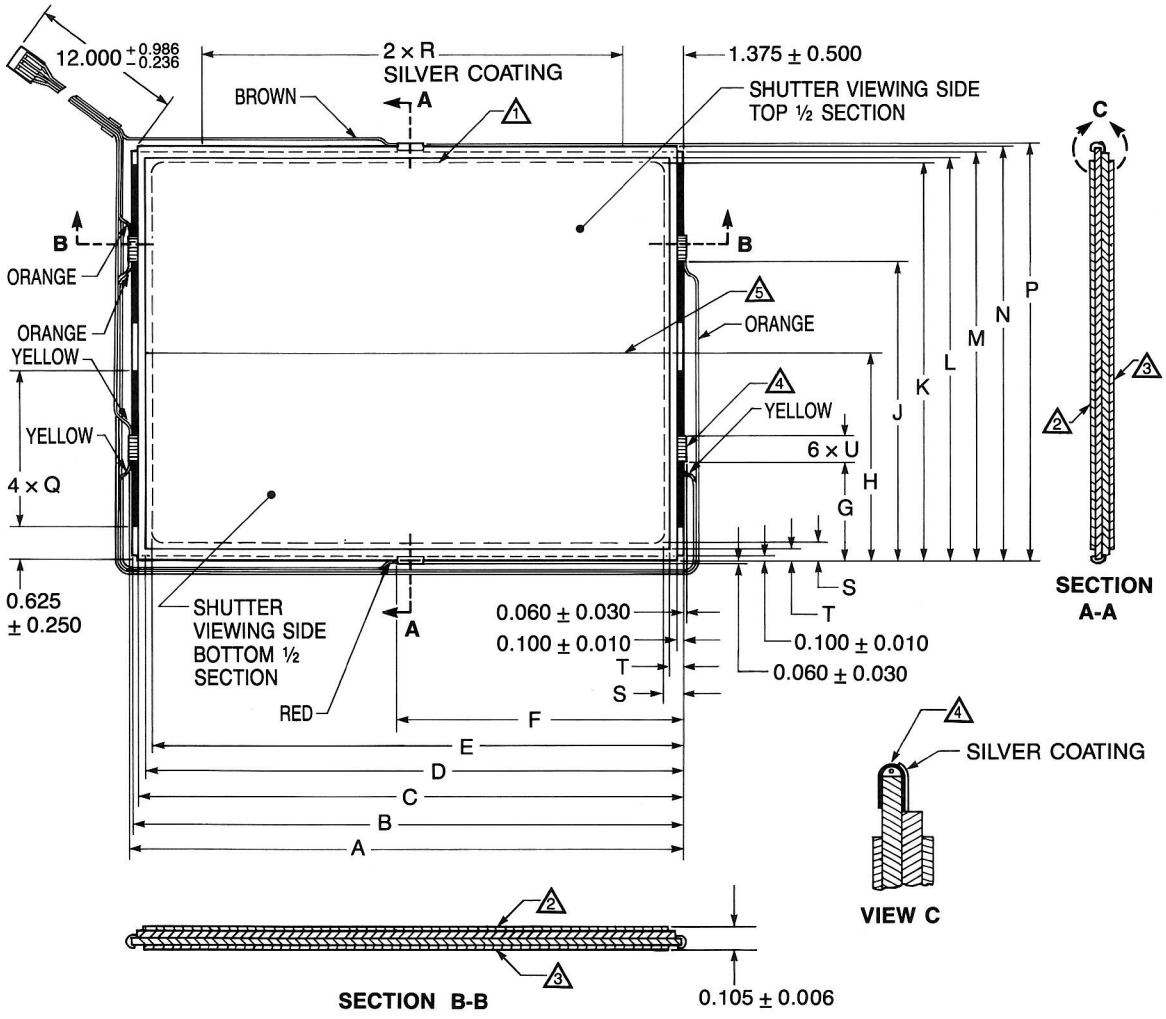

Table 2
Dimensions

SIZE	12" Diagonal	15" Diagonal	19" Diagonal
Quality Area	9.750×7.250 Min	10.800×8.000	14.70×10.800
P/N	808-0008-00	808-0013-00	808-0019-00
A	10.100	11.150	15.250
B	10.225±0.051	11.275±0.051	15.400±0.051
C	10.350±0.014	11.400±0.014	15.650±0.014
D	10.450±0.010	11.500±0.010	15.750±0.010
E	10.510±0.032	11.560±0.032	15.810±0.032
F	5.500±0.500	6.000±0.500	*
G	1.750±0.500	1.900±0.500	*
H	3.975±0.026	4.300±0.026	5.900±0.026
J	5.750±0.500	6.200±0.500	*
K	7.600	8.350	11.300
L	7.725±0.050	8.475±0.050	11.450±0.050
M	7.850±0.014	8.600±0.014	11.700±0.014
N	7.950±0.010	8.700±0.010	11.800±0.010
P	8.010±0.032	8.760±0.032	11.860±0.032
Q	0.300±0.250	3.250±0.250	*
R	8.000±0.500	9.000±0.500	*
S	0.350 MAX	0.350 MAX	0.500 MAX
T	0.225±0.032	0.225±0.032	0.350±0.032
U	0.500±0.100	0.500±0.100	0.500±0.100

Notes:

1. Screen quality area
2. Linear polarizer
3. Color polarizer
4. Connector, six locations
5. Center split line

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